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it certainly has no effect beyond the cortex of the root when transpiration is active. On the other hand, the presentation of the probable relation of evaporation and osmosis in the mesophyll to water transfer is very satisfactory.

The illustrations are remarkably unequal. Some are excellent; some are crude, but sufficient; some are so diagrammatic, without such remark, as to be misleading; and some disfigure a book which deserves the best possible engravings. We suspect some of the worst of being relics of a long-deceased "botany," resurrected from the publishers' stock-room. Many of the illustrations, though not original, are not credited to their sources, while others are; of this no explanation is given.

No references are made to original papers or to other works; only in a few cases is the proponent of any particular view or theory referred to; and controverted points are scarcely alluded to. The danger from this is that the student may get the too common impression that the book deals out finally settled knowledge. It is difficult to know where to draw the line between the necessary dogmatism of the elementary work and the discussion of the treatise, but we believe in showing up the gaps in a subject fully. While this book only professes to be "an introduction," it is nevertheless so thorough that it would have been improved by a *selected* bibliography following each of the various topics. For though we have Pfeffer's treatise at hand, its citations of literature are too detailed for the student of elementary physiology, and he would have profited greatly by the same judicious sifting of the literature as Professor Green has made of the facts.— C. R. B.

The problems of life.

THE FUNDAMENTAL problem of physiology is the constitution of living matter. But we are so far from a knowledge of the chemistry of proteids, not to mention protoplasm, that the best we can do now is to attempt the framing of logical and consistent hypotheses, in the hope that these will suggest research in fruitful lines. If the true character of such hypotheses is kept clearly in view, they may prove helpful, but there is always a danger that the hypothesis may be held so tenaciously that new facts are distorted to fit our interpretation of other facts.

There is before us the first part of a work by Dr. Giglio-Tos, of the University of Turin, which is an attempt to set forth a logical and consistent hypothesis of the organization of protoplasm and its fundamental functions, notably assimilation, reproduction, respiration, photosynthesis, and cell division.[2] A second part is to discuss ontogeny and its problems.

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[2] GIGLIO-TOS, ERMANNO: Les problèmes de la vie: Essai d'une interpretation scientifique des phénomènes vitaux. 1e partie: La substance vivant et la cytodiérèse. 8vo. pp. viii + 286. *figs. 33.* Turin: The author, Palazzo Carignano. 1900. 10 francs.

The general thesis of the book is that vital phenomena are explicable without invoking hypothetical or mysterious forces and are all referable to relatively simple fundamental causes. Since the minutest observable organisms undergo fission, the author makes the assumption that fission occurs also in the molecules of living substance. This he illustrates by the behavior of certain chemical compounds. Methyl-ethyl-ketone, for example, on taking up three atoms of oxygen, cleaves into two molecules of acetic acid. The chemical analogy may be carried further. By treating the acetic acid molecules with phosphorus pentachlorid, and the acetyl chlorid so formed with zinc ethyl, there are finally produced four molecules of methyl-ethyl-ketone and in the course of the process several by-products. Certainly such an analogy, if it be nothing more, renders easily conceivable the author's hypothesis that assimilation of atoms or atomic groups from the medium brings about an increase and a rearrangement of the atoms in each molecule of living substance. When the proper relations within the molecule are reached, it divides into two new ones like the original; or into two (alike) which through a subsequent cycle of development produce molecules like the original; or into two (unlike), only one of which develops and reproduces the original molecule, while the other finally produces again unlike molecules. By assuming this different behavior the author explains the production of nonliving matter by living, and the origin of genetic and somatic plasma.

The respiratory and photosynthetic activities of these living molecules are elucidated in terms of this hypothesis; certainly what we know of them falls in with it easily.

The next assumption is that many unlike biomolecules, to use the author's word for living molecules, are aggregated into living particles, or biomores, in which they have an arrangement determined by the chemical affinity of the various atoms and groups, and shifting as the chemical constitution changes. The life of the biomore, however, does not depend on its constitution but on the life of the biomolecules.

The aggregate of biomores, submerged in water (not of constitution as Nägeli held, but of capillarity), constitutes the bioplasm. Any view as to the morphological structure of the bioplasm, whether the filar structure of Flemming, the reticular of Frommann, the alveolar of Bütschli, or the granular of Maggi and Altmann, is equally consonant with this theory.

The bioplasm is not of indefinite extension but consists of small masses, each a symbiotic system of unlike biomores, constituting a biomonad. A very complex biomonad, especially when biomores constituting a nucleus are present, is a cell.

Cell division is based upon the same fundamental principle as the fission of the biomolecules. In them it is not mere addition of atoms which suffices to bring about division, but their mutual relations and orientation. In the biomores division again depends on the nature, number, *and arrangement* of the biomolecules. In the biomonad, division is possible (1) because the biomores are mobile, being in liquid; (2) because they exercise a mutual attraction (shown by their union into masses giving parts of the cell their definite characters), and consequently assume a determinate arrangement. But division of the cell is completely independent of its structure, though the figures accompanying division, such as the spindle, the equatorial plate, etc., are dependent upon structure. The efficient cause of division is indeed always the same, whether in biomolecule or cell, namely, the mutual orientation of the parts; whatever the number, nature, or structure may be, division is inevitable when the proper arrangement is attained. Assimilation is indispensable to division, but not always sufficient. The discussion of cell division is elaborate and is illustrated by diagrams which make the presentation very clear and the process fascinatingly simple — would that it were so.

Such is a very brief outline of the hypothesis. Of course, it adds nothing to our knowledge, and it would be easy to revile it as an unstable pile of assumptions. But the real questions are, Does it take account of the present facts and coordinate them? Will it suggest fruitful research? That it takes account of all the facts is improbable; that it does fairly coordinate the more important ones (alas, too few) seems evident. That it will stimulate investigation remains to be seen. At any rate it deserves attention for what it purports to be, namely, an attempt to give a scientific interpretation of vital phenomena.— C. R. B.

MINOR NOTICES.

ONE OF THE latest of the series of Temple Primers is a little volume on *Plant life and structure* translated from the German of Dr. E. Dennert by Clara L. Skeat.[3] The author seems to recognize no organisms as plants but the seed plants, and continually makes assertions of the most comprehensive sort which are true only of green plants. Indeed he is rather given to generalizations, both regarding structure and function, and to teleology of the Paley type. In many minor matters and in some important ones the book is not up to the times; Goethean metamorphosis, sexual terms for the sporophyll and microspores, and much faulty physiology might have been more easily forgiven in a book dated a decade or two ago. But the best to be said of this booklet is that it is better than many more pretentious works and good enough for one to regret that it is not better.— C. R. B.

AMONG the plastic products of plants one of the groups most interesting chemically and most valuable commercially is the volatile oils. In their manufacture many firms have been engaged, but none so extensively, so

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[3] DENNERT, E.: Plant life and structure. Translated from the German by Clara L. Skeat. 16 mo. pp. viii + 115, *figs. 56.* London: J. M. Dent & Co. (undated). New York: The Macmillan Company. 40 cents.